REMARKS

Applicant has added new claims 21-29. New claims 21-29 are similar to claims 1-9 with the addition to claim 21 of the phrase "wherein the solid carbon dioxide is already present on a surface of said cryogenic equipment prior to said introducing said stream". Support for claim 21 may be found in Applicant's Publication of the Application US 2006/0144079 A1 at, for example, paragraphs [0005] and [0006].

The Commissioner is hereby authorized to charge any extra claims fees to Shell Oil Company, Deposit Account No. 19-1800.

Claim rejections under 35 U.S.C. 102 as being anticipated by Cole

Claims 1, 2, 5, 6, 8, 10, 11, 14, 18, and 20 have been rejected under 35 U.S.C. 102(b) as being anticipated by Cole et al. ("Cole") (U.S. Patent No. 5,956,971). Applicant respectfully traverses the rejections. Reconsideration and withdrawal of the rejections are respectfully requested in view of the amendments and remarks.

Applicant respectfully suggests that the claim rejections of claims 1, 2, 5, 6, 8, 10, 11, 14, 18, and 20 have been rendered moot by Applicant's amendment of claims 1 and 10 to include language from original claim 3 of further comprising the step of adjusting the relative percentages of ethane and carbon dioxide for a given pressure and temperature such that the mixture of liquid ethane and liquid carbon dioxide is near azeotropic, and Applicant's amendment of claim 11 to include language from original claim 12 of wherein relative percentages of ethane and carbon dioxide are adjusted for a given pressure and temperature such that the mixture of liquid ethane and liquid carbon dioxide is near azeotropic.

As indicated in the Office Action at page 3, Applicant suggests that Cole does not disclose forming an azeotropic mixture of ethane and carbon dioxide.

Regarding new claim 21, Applicant suggests that Cole does not disclose that the solid carbon dioxide is already present on a surface of said cryogenic equipment prior to said introducing said stream.

Cole column 3, line 66 - column 4, line 6, discloses that the process of this invention distillatively separates in a separation system a multi-component feed stream containing methane and at least one freezeable component having a relative volatility of less than that of methane, wherein the separation system contains a controlled freezing zone ("CFZ"). The separation system produces an overhead vapor stream enriched with methane and a bottoms product enriched with the freezeable component. Cole column 4, lines 28-32, discloses that prior to this invention, it was well understood by those skilled in the art that CFZ could remove unwanted CO_2. It was not appreciated that the CFZ process could be integrated with a liquefaction process to produce PLNG (pressurized liquid natural gas, Cole column 4, lines 10-12).

Cole column 4, lines 59-66, discloses that the first consideration in cryogenic processing of natural gas is contamination. The raw natural gas feed stock suitable for the process of this invention may comprise natural gas obtained from a crude oil well (associated gas) or from a gas well (non-associated gas). The raw natural gas often contains water, carbon dioxide, hydrogen sulfide, nitrogen, butane, hydrocarbons of six or more carbon atoms, dirt, iron sulfide, wax, and crude oil. Cole column 5, lines 6-11, discloses that in the following description of the invention, it is assumed that the natural gas stream contains CO_2. If the natural gas stream contains heavy hydrocarbons which could freeze out during liquefaction, these heavy hydrocarbons will be removed with the CO_2.

Cole column 6, lines 2-9, discloses that the CFZ section, which handles solidification and melting of CO_2, does not contain packing or trays like conventional distillation columns, instead it contains one or more spray nozzles and a melting tray. Solid CO_2 forms in the vapor space in the distillation column and falls into the liquid on the melting tray. Substantially all of the solids that form are confined to the CFZ section.

Applicant suggests that Cole discloses forming solid CO_2 that is present in natural gas and does not disclose Applicant's converting solid carbon dioxide to liquid form using ethane. Applicant also suggests that the Cole disclosure of solid CO_2 formed in the vapor space in the distillation column that falls into the liquid on the

melting tray does not disclose Applicant's solid CO_2 present on the surface of cryogenic equipment (see, for example, Applicant's new claim 21).

Cole column 6, lines 36-45, discloses that a first portion of the liquid stream 19 is passed as stream 20 to a suitable storage means 34 such as a stationary storage tank or a carrier such as a PLNG ship, truck, or railcar for containing the PLNG at a temperature above about -112° C. and a pressure sufficient for the liquid product to be at or below its bubble point. A second portion of the liquid stream 19 is returned as stream 21 to the separation column 31 to provide refrigeration to the separation column 31. Applicant suggests that the stream 21 in Cole being returned to the separation column 31 is, for example, PLNG.

Applicant suggests that the solid carbon dioxide being melted and removed as a liquid stream through line 12 as indicated in the Office Action at page 2, is being formed in the vapor space in the distillation column and falls into the liquid on the melting tray and removed from separation column 31 through line 12. Applicant also suggests that the additional disclosure of additional embodiments in Cole, for example, as disclosed in Figure 2 and Figure 3 as well as the examples, are similar to the disclosure in Cole regarding Figure 1 and include the use of a CFZ for removing contaminants from natural gas that does not disclose Applicant's invention.

Claim rejections under 35 U.S.C. 103(a) as being unpatentable over Cole in view of Styring

Claims 3, 4, 7, 12, 13, 15-17, and 19 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Cole et al. ("Cole") (U.S. Patent No. 5,956,971) in view of Styring, Jr. ("Styring") (U.S. Patent No. 4,246,015). Applicant respectfully traverses the rejections. Reconsideration and withdrawal of the rejections are respectfully requested in view of the amendments and remarks.

Applicant has discussed Cole hereinabove and incorporates such discussion herein at this point by reference.

Styring Abstract discloses a method for separating a mixture of carbon dioxide and ethane derived from a prior separation stage. Styring column 2, lines 51-54, discloses that as shown, the carbon dioxide-ethane azeotrope overhead effluent fluids

are cooled in first condenser 19 to condense all the overhead effluent fluids and form a liquefied azeotrope. Styring column 2, lines 54-59, discloses that preferably, the condenser will be operated at a temperature above minus 69.9° F. to prevent the formation of solid carbon dioxide in this condenser. Styring column 2, lines 63-65, discloses that the azeotrope of carbon dioxide and ethane is passed through chiller 23 to freeze the carbon dioxide in the azeotrope.

Applicant suggests that the Styring process of utilizing a condenser and preventing the formation of solid carbon dioxide followed by the use of a chiller to freeze the carbon dioxide in the azeotrope teaches away from the combination with the Cole disclosure of forming solid CO_2 to remove the CO_2 as a contaminant of natural gas.

Applicant also suggests that a combination of Cole and Styring would produce an unpredictable result because the Cole process that is directed to removing contaminants such as CO_2 from feed gas using, for example, PLNG in line 21 would instead be using the Styring azeotropic mixture. For example, the combination of Cole and Styring would result in line 21 being the azeotropic mixture of ethane and carbon dioxide that would enter the separation column 31 above the CFZ zone that is disclosed in Cole.

Claim rejections under 35 U.S.C. 103(a) as being unpatentable over Cole in view of Apffel

Claim 9 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Cole et al. ("Cole") (U.S. Patent No. 5,956,971) in view of Apffel ("Apffel") (U.S. Patent No. 4,861,360). Applicant respectfully traverses the rejections. Reconsideration and withdrawal of the rejections are respectfully requested in view of the amendments and remarks.

Applicant has discussed Cole hereinabove and incorporates such discussion herein at this point by reference.

Apffel Abstract discloses a process for the separation of hydrocarbon feed gas mixtures containing carbon dioxide. The Office Action at page 3 discloses that line 200 of Apffel shows the return of solvent to an absorbing system is known in the art.

The Office Action at page 3 further indicates that it would have been obvious to one of ordinary skill in the art at the time of Applicant's invention from the teaching of Apffel to modify the carbon dioxide removal system of Cole by returning regenerated solvent to an absorbing column to reduce the amount of solvent required to run the process.

Apffel column 2, line 64 - column 3, line 6, discloses that the distillation and absorption process method disclosed avoids the potential formation of carbon dioxide solids by first separating a mixture of methane, lighter components, ethane and carbon dioxide from propane-and-heavier hydrocarbons in a first column. The degree of efficiency of separating the carbon dioxide and ethane between the top and bottom product is not critical. Consequently, carbon dioxide and ethane are found in both top and bottom products. The temperature and pressure required for this separation is such that no solid formation of carbon dioxide will take place.

Apffel column 16, lines 52-59, discloses that the advantage of the art disclosed by the first embodiment process over the Ryan/Holmes separation system discussed in the "Background" also applies for this alternate embodiment in that no solid formation of carbon dioxide will take place in the distillation and absorption separation systems described herein because the minimum temperature required is -40°F. which is well above the freezing point of carbon dioxide.

Applicant suggests that the Apffel disclosure of, for example, steps of a process that prevent the formation of solid carbon dioxide teaches away from combining with Cole that is directed to the formation of solid carbon dioxide.

Apffel column 5, lines 4-19, generally describes the Apffel Methanol Absorber 136 and that stream 135 is fed to the bottom of the Methanol Absorber 136. The vapor and liquid are separated in the bottom of the Methanol Absorber 136. The uncondensed methane carbon dioxide and ethane gas flow up the absorber countercurrent to the downcoming "lean" methanol, which absorbs the carbon dioxide. ethane and not the methane. In this context, "lean" methanol means methanol that has been essentially stripped free of ethane. carbon dioxide and other hydrocarbons. The "lean" methanol feeds the top of the Methanol Absorber 136 in stream 200 at temperatures of -35° to 10° F. Applicant suggests that the Apffel stream 200 is returning solvent to the Methanol Absorber 136.

Applicant suggests that the Apffel routing back of the solvent to the Methanol Absorber to absorb the carbon dioxide. ethane and not the methane does not disclose Applicant's routing of the stream that includes ethane that is recycled to the step (a) to be used for removing solid carbon dioxide.

CONCLUSION

Applicant respectfully requests reconsideration and withdrawal of the claim rejections under 35 U.S.C. 102(b) and 35 U.S.C. 103(a). Applicant further respectfully requests entry and consideration of the above amendments and remarks to advance the above-identified application to allowance.

Respectfully submitted,

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